Vol. 17 AUGUST, 1952 No. 8

CORNELL-DUBILIER ELECTRIC CORP.
Hamilton Boulevard, South Plainfield, N. J.

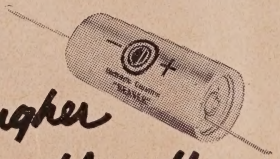
POSTMASTER: If undeliverable for any reason, notify stating reason, on Form 3547 postage for which is guaranteed.

Sec. 34.66 P.L.&R.
U. S. POSTAGE
PAID
So. Plainfield, N. J.
Permit No. 1

MR JOHN J GERIG W6NHU
110 SIMS AVE
VALLEJO CALIF

C-D's Blue Beaver

- The only electrolytic capacitor designed and built *specifically* for servicemen.
- 50% *"safety factor"* — makes allowance for changes in set caused by previous servicing, aging of components, etc.
- Elimintes costly comebacks. Millions in use!
- Write for Catalog 200C, Cornell-Dubilier Elec. Corp., South Plainfield, N. J. Your local Classified Phone Directory lists your nearest C-D jobber.



50% tougher than the job calls for!

CONSISTENTLY DEPENDABLE

CORNELL-DUBILIER CAPACITORS

SUBSIDIARY

Plants in South Plainfield, N. J.; New Bedford, Worcester, and Cambridge, Mass.; Providence, R. I.; Indianapolis, Ind.; Fuquay Springs, N. C.; and subsidiary, The Radiart Corp., Cleveland, Ohio

Printed in U.S.A.

SUBSTITUTION METHODS IN CAPACITANCE MEASUREMENT

Low capacitances, especially from 100 uufd. down, are particularly important in high-frequency circuits. These capacitances are selected by design but they can be of considerable concern also when they appear by accident as stray circuit parameters. The problem of checking small capacitance values accurately becomes apparent to the student of electrical measurements as soon as the limitations of conventional methods are noted. Familiar members of the small-capacitance domain are low-value fixed and trimmer capacitors, terminal-to-terminal capacitance, terminal-to-ground capacitance, lead capacitance, tube interelectrode capacitance, and socket terminal capacitance.

The direct measurement of small capacitances usually is complicated by stray capacitance in the measuring instrument itself. This stray characteristic is especially disturbing on the low ranges which normally would be used. For that reason, it is desirable to employ an indirect method of measurement, in order that the effects of all strays might be compensated automatically. Substitution methods fall into this category. There are several ways of using substitution methods with conventional test instruments to obtain greater accuracy of small-capacitance measurement. These methods are described in this article.

Principle of Substitution Method

Figure 1 shows a basic setup for substitution measurements of capacitance. This arrangement, which will serve to illustrate the method, often is employed in laboratories. Instruments required are a capacitance bridge and a variable capacitor with dial calibrated for direct reading in micromicrofarads.

The first step in using this arrangement is to set the variable capacitor to some capacitance (C_1) near its maximum and to connect it to the bridge. Short, rigid leads are used. Next, the bridge is adjusted for null. Thereafter, the bridge setting must not be disturbed. Note that this setting of the bridge includes all of the capacitance in the circuit — the total of strays and the capacitance setting (C_1) of the variable capacitor. Finally, connect the unknown small capacitance to termi-

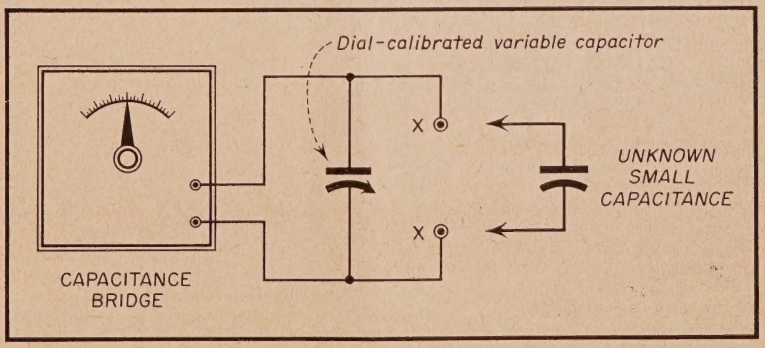


Fig. 1. Basic setup for substitution measurements.

nals X-X in parallel with the variable capacitor and bridge, using the shortest possible leads. Since the capacitance connected to the bridge now has been increased by the amount of the unknown, the bridge unbalances.

Null is restored by **reducing** the setting of the variable capacitor to a new capacitance, (C_2). This removal of capacitance from the original setting of the variable capacitor thus compensates for the presence of the unknown unit. The unknown capacitance then is equal to $C_1—C_2$, the difference between the two settings of the variable capacitor required for null. In other words, the unknown capacitance is equal to the amount of capacitance which must be subtracted by means of the variable capacitor in order to restore the circuit capacitance to its initial value.

Illustrative Example: The variable capacitor is set to 1000 uufd. and the bridge balanced to a sharp null. C_1 thus is 1000. The unknown capacitance (C_x) is connected into the circuit, and the variable capacitor setting reduced to restore null. At the new null point, the variable capacitor dial reads 988 uufd. which is the value of C_2. In this case, $C_x = C_1—C_2 = 1000—988 = 12$ uufd.

This method of measurement affords higher accuracy than the direct method because (a) the initial null balance automatically compensates for stray shunting capacitances within the instrument and the setup and removes the necessity for correcting for the "zero" capacitance of the measuring instrument; and (b) the initial setting (C_1) of the variable capacitor is at or near the maximum capacitance of this unit, where settings are relatively free from disturbances due to small physical movements and to strays. Furthermore, smaller capacitance changes may be read on the dial of the variable capacitor than are possible with the bridge alone. Note that the bridge serves merely as a null indicator in this setup, the actual readings being taken from the dial of the variable capacitor.

The maximum capacitance which may be accommodated directly by this particular method of measurement is restricted by the difference between maximum and minimum capacitance settings possible with the variable capacitor used. Thus, if the capacitor dial is graduated for continuous reading between 100 and 1000 uufd., the maximum capacitance that can be measured is 1000—100, or 900 uufd.

Thus far, nothing has been said about power factor or Q balances of the bridge (if a bridge is used as the null indicator) and the effect of these balances upon the adjustments of the variable capacitor. Actually, there is no deleterious effect. The variable capacitor, being air-tuned, has a high Q value approaching infinity (low power factor), and the power factor balance may be assumed to apply only to the unknown capacitor under test.

The type of substitution method just described requires an accurately-calibrated, ruggedly-constructed variable capacitor. Standard units of this type are available in laboratory grade. When economy is a factor, however, as usually is the case with experimenters, service technicians, and small laboratories, a satisfactory substitute can be made using a soundly-built 100-, 500-, or 1000-uufd. tuning capacitor, preferably with plates cut for a straight-line capacitance curve. A micromicrofarad calibration of the dial may be provided by standardization against another capacitance standard.

Substitution Method for Large Capacitances

Large capacitances outside of the range of a bridge or other available capacitance-measuring instrument also may be checked by means of a substitution method of measurement. Although a number of service technicians give attention to this method from time to time, quite a few have become confused in the calculation.

Figure 2 illustrates the method. Here, a capacitor (C_s) of accurately-known value is connected in series with terminals X-X which are short-

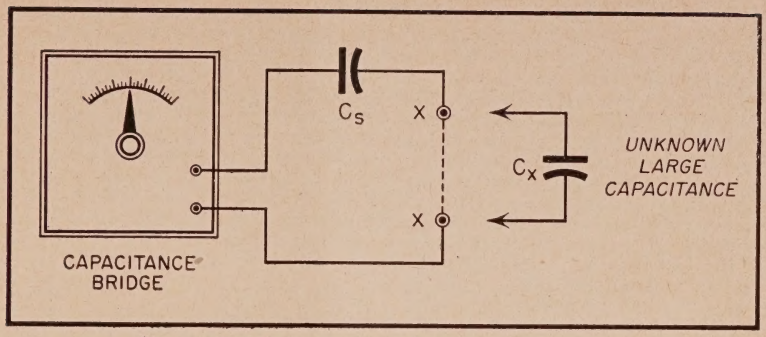


Fig. 2. Substitution measurement of large capacitance.

circuited temporarily by means of a short jumper. The capacitance reading for C_s then is read from the instrument and recorded as C_1. Next, the jumper is removed and the unknown capacitance connected to terminals X-X. The unknown thus is connected in series with C_s. The new capacitance, read from the instrument, is recorded as C_2. The unknown capacitance (C_x) is equal to:

$$C_x = \frac{C_1^2}{C_1 - C_2} - C_1$$

Illustrative Example: A 1000-uufd. capacitor is selected as C_s. The initial reading C_1 then is 1000. When the unknown capacitance is connected into the circuit, a reading (C_2) of 910 uufd. is obtained. The unknown capacitance (C_x) then equals:

$$\frac{1000^2}{1000-910} - 1000 = \frac{1{,}000{,}000}{90} - 1000 =$$

11,111—1000 = 10,111 uufd. = 0.0101 ufd.

Substitution Method in Capacitance-Tuned Bridges

Figure 3 shows the skeleton circuit of a capacitance bridge having a direct-reading variable capacitor, C_v, as its adjustable arm. Bridges of this type are used at both audio and radio frequencies.

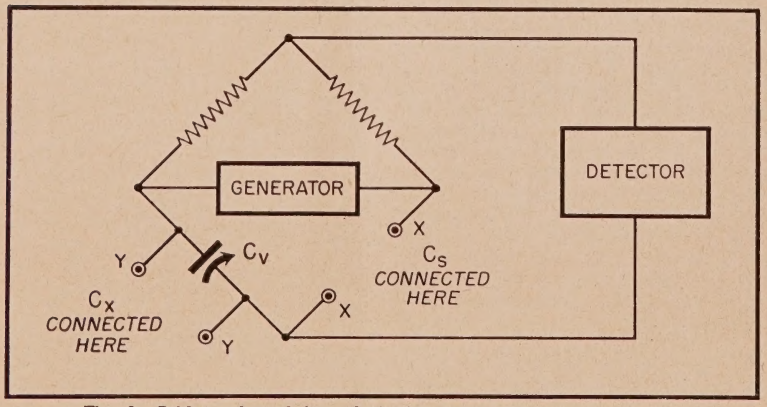


Fig. 3. Bridge adapted for substitution capacitance measurements.

The unknown capacitance **normally** is connected, for direct measurement, to terminals X-X, the bridge balanced by adjustment of C_v, and the unknown capacitance value read directly from the calibrated dial of C_v. The **substitution** method may be employed with this bridge, using the internal variable capacitor, C_v. Terminals Y-Y are provided for this purpose. Such terminals are available on some laboratory-type bridges of the capacitance-tuned type.

The bridge is set initially by connecting to terminals X-X a capacitor having a value near the full-scale setting of C_v. The accuracy of this capacitor is unimportant. The setting of C_v then is recorded as C_1. The unknown capacitance is then connected to terminals Y-Y, and capacitor C_v detuned to reduce its setting to restore null. At the new null point, the setting of C_v is recorded as C_2. The unknown capacitance then is determined from the relationship $C_x = C_1 - C_2$.

It is to be noted that this variation, or any of the other methods of substitution measurement of capacitance, will not compensate automatically for stray capacitance in the unknown unit. Such strays are introduced by the leads to the unknown capacitor. The effect of lead capacitance may be nullified to some extent by connecting the leads alone first to terminals Y-Y and setting C_v for initial balance. The unknown capacitor then is connected to the leads carefully without disturbing their position. When the unknown capacitor has pigtail leads, it may be connected to terminals Y-Y for the initial setting, but with one pigtail disconnected and its tip separated from the corresponding Y terminal by a short distance, say 1/8 to 1/8 inch. After the initial setting, the lead is inserted into the Y terminal.

Other Instruments for Substitution Measurements

R. F. Oscillator. Any convenient, high-stability radio-frequency oscillator may be used for substitution capacitance measurements provided its tank tuning capacitor is provided with a direct-reading capacitance dial. The tuning capacitor first is set to its maximum capacitance (C_1) and the frequency of the oscillator measured with a convenient frequency meter. The unknown capacitor (C_x) then is connected in parallel with the tuning capacitor, using the shortest possible leads, and the tuning capacitor detuned to a second lower setting (C_2) to give the same oscillator frequency. The value of the unknown capacitance C_x is equal to $C_1 - C_2$.

Q-Meter. The standard Q-Meter checks capacitance values at radio frequencies by means of the substitution process. The measuring circuit of the Q-Meter is shown in Figure 4. C_1 is a rather large variable capacitor, having a maximum capacitance near 500 uufd. C_2 is a small variable trimmer with a range of only a few micromicrofarads. With C_1 and C_2 both set to their maximum positions; the L-C circuit is resonated, as indicated by peak deflection of the v. t. voltmeter, by varying the frequency of the input radio-frequency voltage from an oscillator. The unknown capacitance then is connected to terminals X-X and C_1 or C_2 reduced to restore peak deflection of the meter. The unknown capacitance then is equal to the difference between the two tuning capacitor settings for meter deflection. For very small unknown capacitances, trimmer C_2 alone is varied, C_1 being left at its maximum capacitance setting.

Grid-Dip Oscillator. The grid-dip oscillator, familiar to most amateurs and service technicians, is employed in a manner similar to the Q-Meter. In this case, however, an external L-C circuit must be provided. The latter may consist of a rigid coil of a few turns of wire connected in parallel with a direct-reading variable capacitor. The variable capacitor is set to its maximum capacitance (C_1), the grid-dip oscillator coupled loosely to the coil and tuned for resonance as indicated by complete dip, and the reading C_1 noted. The unknown capacitance then is connected in parallel with the variable capacitor and the latter detuned

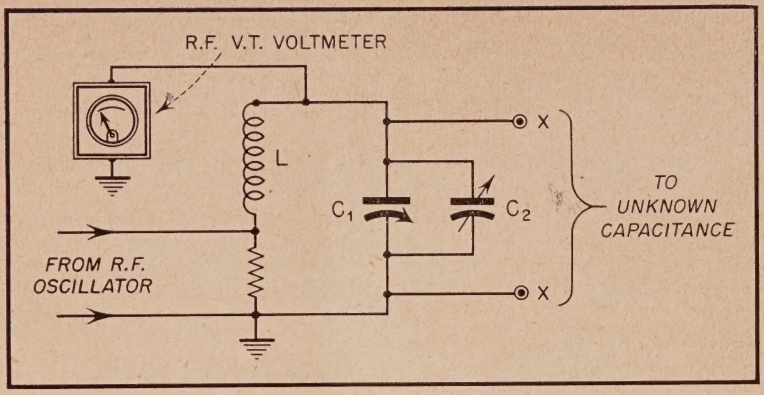


Fig. 4. Q-meter capacitance-checking circuit.

to re-establish resonance. The new variable capacitor setting is recorded as C_2, and the unknown capacitance determined from $C_x = C_1 - C_2$.

Twin-T Network. Another null instrument employing a variable capacitor in one of its arms is the Twin-T Impedance-Measuring Network, shown in rudimentary form in Figure 5. Like the other circuits, this network is set initially to null with the tuning capacitor, C_1, at its maximum capacitance. The unknown capacitance then is connected to terminals X-X in parallel with the tuning capacitor which then is detuned to restore null. As before, the difference between the two settings of the variable capacitor indicates the value of the unknown capacitance.

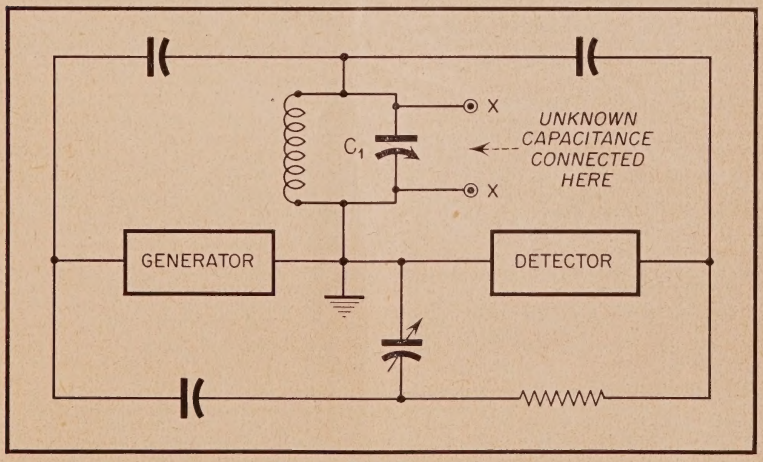


Fig. 5. Twin-T network.

CORNELL-DUBILIER

CAPACITOR ANALYZER

Model BF-50

The Model BF-50 Capacitor Analyzer quickly and accurately measures all important characteristics of all types of capacitors. It offers the most accurate and thorough capacitor test of any instrument of its type, and may be operated on any 110-volt, 50-60 cycle power line.

The analyzer will determine the true condition of all paper, mica and electrolytic capacitors, including A.C. motor-starting types.

FEATURES OF MODEL BF-50 ANALYZER

1. Measures Capacity—Accurately measures capacity of paper, mica, air, electrolytic and motor-starting capacitors from .00001 to 240 mfd.
2. Measures Power Factor—Measurements of power factor from zero to 50 per cent on all types of electrolytic capacitors including motor-starting types.
3. Employs Wien Bridge—Assures permanent accuracy of capacity and power factor measurements. Readings not affected by line voltage variations.
4. Indicates Insulation Resistance—Insulation resistance measurements of paper and mica capacitors up to 1500 megohms. Also measures many types of insulation.
5. Indicates Leakage—Measurements of leakage of electrolytic capacitors by means of built-in direct current power supply.
6. Visual Eye Leakage Indicator—Provides simplified and reliable leakage tests on all types of capacitors. Enables measurements to be made rapidly.
7. Detects Defective Capacitors — Character measurements, such as leaky, shorted, open, high and low capacity, and high power factor on all capacitors.
8. High Sensitivity on All Measurements—Amplifier for capacity, power factor and leakage tests provides sharp and accurate readings. Amplifier built-in Analyzer.
9. Balance Sensitivity Control—Provides sharp or broad balances for quick and accurate readings. All readings are made simply and directly.
10. Direct Reading Linear Scale Calibration—Provides simplified measurements. All scales on panel uniformly spaced, easy to read, thus avoiding possible errors in using multipliers or charts.
11. Push-Button Switching—For convenient and simplified adjustments, all tests and circuit changes are made by means of modern push-button switches.
12. Visual Eye Bridge Balance—Visual detector gives positive indication of bridge balance for convenient, simplified and accurate capacity and power factor measurements.
13. Six Color-Coded Scales—Accurately calibrated, six color-coded scales. Uniformly spaced over total spacing of sixty inches. Easy to read. No "blind" spots.
14. General Purpose Instrument—May be used to check continuity capacity between circuits, insulation of transformer windings and other types of coils, etc.
15. Self-Contained — Portable—An instrument complete in itself, requiring no external standard, headphones, meters or accessories. A portable unit, for 110 volt, 50-60 cycle operation, supplied in walnut cabinet, removable cover, with carrying handle. Size, 6½ x 12 x 9¾ inches. Weight, 9 pounds.

MODEL BF-50 CAPACITOR ANALYZER
Net Price complete with tubes **$46.92**

AT YOUR CORNELL-DUBILIER DISTRIBUTOR

This CORNELL-DUBILIER Advertising Service is FREE to "Capacitor" readers. If there is anything of general interest or appeal that you want to BUY — SELL — or SWAP . . . if you want a job or need help, these columns are at your service.

Please PRINT or TYPE your Ad clearly and limit it to 40 words including your name and address.

If you have a "CHANGE OF ADDRESS" — give both your OLD and NEW and mark your request "For C-D Capacitor Mailing List."

Ads are published in the order received and as space permits. If your Ad does not appear in one of the two issues following the month in which you submit your Ad — please RESUBMIT it.

CORNELL-DUBILIER ELECTRIC CORP. reserves the right to edit your Ad to conform to its policies and is the final judge of its suitability for publication. We do not assume any liability or responsibility for any transaction that results. Make your deal direct with the advertiser listed in the Ad.

FOR SALE—RCA auto radio mod. 107, recently overhauled, incl. new vibrator and buffer condensers; now operating in D-14 Dodge spkr; mounts behind instr. panel. Best offer FOB Atlanta. C. Duncan, 338 Candler, R.D. S.E., Atlanta, Ga.

SALE OR TRADE—5 Motorola fuel pump and 4 Motorola defroster for heater in orig. cartons; Pre-cis-ion fuel pump tester. $10 for lot or make offer on items. Trade for usable mike or port. phono. Sahr Radio, Fairmont, Minn.

FOR SALE—NRI mod. 88 sig. gen., used very little; NRI Service Man. vol 1; Ghirardi's Modern Radio Servicing. Best offer. Harold G. Brown, 49 Benton Ave., Benton Station, Me.

FOR SALE—SX71 Hallicrafter rec. with R.46 spkr, used approx. 7 hrs. $175, express collect. Robert A. Werner, Jr., 3600 Chestnut St., Laureldale, Pa.

FOR SALE—RCA TV sweep gen. WR 59A RCA TV calib. WR39A, RCA scope WO-55A; all hardly used, $350. Precision sweep gen. E-400 $80, Supreme 3" scope $40, Fada 799 10" (630 chassis) $80. V. Iavarone, 1218 Leland Ave., Bronx 72, N. Y.

TRADE—Meissner 8C FM receptor; exc. cond.; RCA dynamic mike and desk stand, less plug; 2 ¼ hp 110V 60c mot. Will trade for test eqpt. Harold Betzer, 4311 1st Ave. S.E., Cedar Rapids, Iowa.

FOR SALE—UTC A-10 transformer ultra compact audio low Z mike, pickup, line to grid $7; UTC HA-114 Hi Perm P.P. low level plates to line $8 M.O., FOB. W. S. Crooks, Stow, Ohio.

SALE OR TRADE—National NC108 FM tuner-rec.; Zenith prewar World-wide port.; Sprayberry radio course; US post. stamp mixt. for collectors, 100 lb. lots. Want press camera, tape recorder, 35mm slide projector, Instructograph, printing press. Don Maust, 216 Coolspring St., Uniontown, Pa.

WANTED—20" Hi-fi speaker in perf. cond. M. Schloss, 34-24 82 St., Jackson Heights, N. Y.

SWAP—Savage .32 automatic for RCA Senior VOM mod. WV-97A; 35mm Argus C3 coated lens camera for 3" RCA scope WO-57B, WR-59B sweep gen. and cash. Joseph Lishok, 106 Monroe St., Lawrence, L. I., N. Y.

FOR SALE—Complete 2¼ x 3¼ Speed Graphic camera with f4.5 lens and Turner 33D mike. Swap for receiver, will ad cash. Herbert Paskin, 1402 Brooklyn Ave., Brooklyn 10, N. Y.

SALE OR TRADE—Operadio intercom, 20W amp., Keystone projector mod. D752, Howard FM converter, 15 assted. meters, other items. Want Rider Manuals. E. K. Chenoweth & Son, 845 Union St., Warren, Ohio.

SALE OR SWAP—HO gauge scale model railroad eqpt. Want NC-57B rec. in good cond. Dan Toomey, 37 Leonard St., Glens Falls, N. Y.

WANTED—Complete home study course from recognized radio school, with or without equipment. H. D. Fry, 6200 Wayne Ave., Philadelphia, Pa.

FOR SALE—BC-375-E with 4 TUs less dyna.; SCR 518-A less tubes, like new; Keyer TG-10-F with 10 tapes; 2 BC654-A less dyna's; BC-221-AH with books. John Chazick, 1360 Cleveland Ave., Flint 3, Mich.

WANTED—Good communication receiver. Will trade Rider Manuals. R. C. Banta, 92 Edison St., Wilkes-Barre, Pa.

SALE OR TRADE—Standard TV tuner; Want small caliber pistols or ham trans. parts. Also 3105kc xtals unmounted. Frank W. Vedral, 4378 W. 25th Pl., Chicago 23, Ill.

FOR SALE—Rider TV Manuals 4 and 5 $35. Phil Chiarello, 117-54 125 Street, South Ozone Park 20, N. Y.

SWAP—Scott Lab. rec. C2C46209; 312 Fed. enlarger; Kodak Precision A enlarger; Holmes 35mm proj. and sound system; Wanted 4 x 5 press camera with Cpl. range finder and Omega D2 enlarger. Gerald Hess, 15 Park St., Moravia, N. Y.

SALE—Port. 2 speed disc recorder with PA system; port. wire recorder-radio-phono comb.; RCP tube-set tester 802N, tests all tubes; Simpson 260 VOM and case. Recorders—local sale only. F. Fellows, 45-27 170th St., Flushing, N. Y.

FOR SALE—ARR-2 airc. rec., all tubes and dynamotor $15; BC929-A scope unit, all tubes $25; TS 69 freq. meter $50; Solar CE exameter with VTVM $30; Telerad freq. standard $50; Mr. Larson, 14 E. 30 St., New York, N. Y.

FOR SALE—National Select-O-Ject, like new, mod. SOJ-2 $16. M. G. Wheeler, 1531 Catalpa St., Louisville 11, Ky.

SALE OR SWAP—Rider vols. 8-14, good cond. Make me an offer. Hamilton Radio Sales & Service, Anna, Ill.

SALE OR TRADE—Raytheon 8BP4 guaranteed cond. $15 shipped FOB Pittsburgh; Weston mod. 695 AC volt and DB meter $15 plus shipping chg. Lucian A. Spriggs, 155 Wellington Ave., Washington, Pa.

FOR SALE—TU-69 RF unit with 3 815's. Output freq. of 50.4 mc. with 4200 kc. crystal in oscillator. A. A. Polityka, 248 Western, Allegan, Mich.

WANTED—Short wave rec. and xtal transmitter not over 75W. Prefer local deal. Alex Skowron, 28 Lincoln Ave., Central Falls, R. I.

FOR SALE—Code oscillator with key and earphone, used very little, $5.50 postpaid. Thomas Johnson, Box 932, Tuscaloosa, Ala.

FOR SALE OR TRADE—BC-221 freq. meter in exc. cond. $40 FOB, or will trade for photo exposure meter in new cond. F. E. Dace, 107 Armstrong Pl., Peoria, Ill.

FOR SALE—Hallicrafters S-38A and S-40A, $37 and $75 respectively; both in perf. cond. Laurence Weiner, 3316 Grand Ave., Detroit 6, Mich.

WANTED—Older models Philco table mod. AC radios, any cond. State model, condition, cash price. Joseph A. Spalla, Plaza, N. Dak.

WANTED—6 and 12 volts aircraft transmitters and rec's, BC 412 radar oscilloscope; state price and cond. Leonard A. Schoeller, R. 8 White Bear Branch, St. Paul 10, Minn.

WANTED—8BP4 picture tube in good condition, or information on converting Motorola TS-18 chassis for larger tube. Carl F. Comnick, 8642 12th Av. S.W., Seattle 6, Wash.

SALE OR TRADE—Philco mod. ST12 6 tube custom built car radio $27.50; GE AC voltmeter no. 120 in case $25.75; 10 station push button Inter Comm Master Station, $45.50. Prices FOB. R. C. Wilmarth, 927 9th Ave., San Diego, Calif.

FOR SALE—N. Y. City area only, radio shop, all or part; meters and manuals. B. Cohen, 3042 6th St., Bklyn 35, N. Y

FOR SALE—Meissner signal shifter with 2 line filter cond. $50; Lafayette Lester converter $25. Both for $70. Allan W. Porsch, P.O. Box 415, Brookville, Pa.

FOR SALE—Eico VTVM model 221, $20. Eddie Siletti, 154-14 28th Ave., Flushing 54, L. I., N. Y.

SALE OR SWAP—Rider Man. 3-14; want 500W 8mm projector in good cond. or $8 each. Gladys Goozay, 74 Carlisle St., Rear, Lowell, Mass.

SALE OR SWAP—8mm movie camera $50; steel guitar and amp. $125. Want radio test eqpt. or Philco TV set. Peter F. Kopp, Mandan, N. Dak.

WANTED—Scott radio chassis or console, high quality amp., speakers, Zenith Transoceanic. Cash or will trade high quality 35mm Contax and Rolleicord cameras. L. W. Emens, 156 Jewel St., Ferndale, Mich.

FOR SALE—Radio and TV books; RCP multitester no. 446 plus schematic and instructions $10; asst. of drafting eqpt.; 2 Kodak 120 folding cameras. Send self-add. envelope to A. Kriegel, 701 Crotona Pk. north, Bronx 57, N. Y.

WANTED—Tape recorder, any kind, any size. Please send all information to Eugene Kon, 1575 Broadway, Buffalo 12, N. Y.

FOR SALE—Late DeForest Radio and TV course incl. kits $60; scope, sig. gen., volt ohmmeter and power supply, wired. Robert H. Bauman, 1531 Strader Ave., North Sacramento, Calif.

SALE OR SWAP—10BP4 10" picture tube, like new. Want Rider Man. 6-13 or test eqpt. other than tube tester, or make offer. Alfred H. Wentzel, 2445 Grand St., Mt. Penn, Reading, Pa.

FOR SALE—Rider Man. 1-20, good cond.; Rider Chanalyst mod. ELAX; Solar capacitor analyzer; Electronic Designs volt ohmmeter. Carl L. Yahnke, 227 Herrick St., Albion, N. Y.

FOR SALE—Meissner analyst, comp. with tubes, prods and instr. book $60. Berman Distributing Co., 1188 Broadway, Brooklyn 21, N. Y.

FOR SALE—Complete radio repair eqpt., worth $2,000, will take $1,500; $1,265 worth of tubes for $1,000. Mrs. H. M. Rudolph, 1110 N. 13th St., Paducah, Ky.

FOR SALE—Radio and TV Service, estab. over 6 years, same owner, very well equipped, shelving, benches wired, manuals, good reputation, low rent. Stanley Radio Service, 3616 Tibbett Ave., New York 63, N. Y.

SALE OR SWAP—Sam's 1-146 sig. tracer; Jackson osc. no. 640; Jackson cond. tester no. 650A; Eico VTVM no. 221; Heath tube tester no. TC-1; Heath TV osc. no. TS-2; Sylvania scope 7" no. 132; Stancor 6V pack, BC348-K. C. Whiter, R.D. 1, Ilion, N. Y.

FOR SALE—SX-43 Hallicrafter rec. in good cond $125 FOB. Arthur E. Carter, General Delivery, Winston-Salem, N. C.

FOR SALE—EC-200C Precision sig. gen.; 610-P Precision tube tester, receiving tubes, all like new. Write for list. Arthur L. Dykeman, W4206 Sanson, Spokane 15, Wash.

FOR SALE—GE rec. and transmitter mod. BC645A; Dynamotor type 41S1 input 13/26V DC output 400V rec. and transmitter $20 and dynamotor $8, both never used. Al's Radio & Electric, Ivanhoe, Minn.

SELL OR TRADE—Philco car radio for '41 to '49 Chev. in A-1 cond.; Wirgin 35mm camera. Name your price. C. H. Messick, Box 29, Hebron, Md.

FOR SALE—Eico tube tester mod. 625 and Eico 5" oscilloscope mod. 425, both used only few hours. Make offer on either or both. C. Valentine, 29 W. Hamilton Ave., Englewood, N. J.

SALE OR TRADE—Back copies of QST Radio News CQ and all types of radio tech. books. Want Rider TV Man. Weir Radio & TV, P.O. Box no. 281, Nantasket Beach, Mass.

SALE OR TRADE—Rider Mans., tubes, books, radio parts. Need 35mm camera, 7 x 50 binoculars. Hallicrafter S-72, S-40, or N.C. 57. G. H. Swiska, 109 E. School St., Woonsocket, R. I.

FOR SALE—Comp. set of books incl. experiments. NRI Course, Radio & TV, excellent cond. $35 or make offer. Alfred H. Owen, 6552 Maurice, St. Louis 9, Mo.

FOR SALE—Set of Coyne's Practical Applied Electricity; Rider's 16 and 17; neon transformer; misc. rec. tubes. Send for list. Tape recorder, like new $100. Denver Wells, 1510 Grand, Canon City, Colo.

WANTED—Meissner 8C or 8CC FM tuner; must be in perf. cond. and reasonable. Casimer A. Kusak, 111 Hirschbeck St., Buffalo 12, N. Y.

FOR SALE—Rider Man. 1-14 or Radio vol. 1 and 2 on TV $75; Sylvania 131 3" scope $50. Bud's Radio & TV Service, 5912 Hampton Ave., St. Louis, Mo.

TRADE—Mod. 710 RCP sig. gen.; Turner 33D dynamic mike with switch; Supreme 599 tube and set tester. Want Speed or Century Graphic camera. Norman Rowe, 23 Grove St., Dover, N. H.

SWAP—TS-159 150-200 Mc. freq. meter; approved 300A TV sig. gen. 13 channel GI front end; Sky Buddy; 7GP4 tube; Silver 915 grid dip. Want low freq. sig. gen. or? E. Bembenek, 20 Lombardy St., Brooklyn 22, N. Y.

SWAP—50 lb. self-contained air compressor and spray gun for 10W amp., mike, record changer and speaker. Burt V. Manigold, 804 So. W29, Oklahoma City, Okla.

FOR SALE—Rider vols. 1-15 and indexes, Sam's Photofacts vols. 1-3 $140; Hickok traceometer mod. 156, make offer. Also misc. service volumes from sale of shop. Everything like new. Stanley T. Dixon, 1817 Doane Ave., Mountain View, Calif.

SELL OR SWAP—National Schools Correspondence Course with parts, comp. Want tube tester or cash. A. Jacobowitz, 1695 Topping Ave., Bronx 57, N. Y.

WANTED—Wire recorder, typewriter. Give best price, or trade for Hallicrafter comm. rec. Joseph M. Malak, Center and Sperry roads, Chesterland, Ohio.

WANTED—Coin operated radios. State quan., price, make, mod. and cond. S. Gittelman, 435 Alabama Ave., Brooklyn 7, N. Y.

WANTED—Tube tester and battery eliminator. Please state make and price. E. Paler, 3699 W. 134th St., Cleveland 11, Ohio.

FOR SALE—Sacrifice. 546A 3" laboratory type oscilloscope suitable for TV incl. marker screen and operators' man. used 5 months; orig. price $107, first $50 takes it. B. S. Swink, 336 W. 11 St., New York 14, N. Y.

FOR SALE—200W CW trans., 813 final, 6L6 doblers, home made, $90 or make offer; BA-1-6521. A. A. Ketteringham, 871 33rd Ave., San Francisco 21, Calif.

WANTED—GE 16-20" chassis without pix tube and cabinet. Trade Precision E-200 Bliley xtal control gen., 49-50 Chev. radio, Triplett 1632, NRI Professional sig. tracer, 803's and BC-312. Jim Wright, 2319 E Independence, Phoenix, Ariz.

FOR SALE—Back issues of Radio Television News and Radio-Electronics, 40c per copy. J. J. Cannon, 143 High St., Mauch Chunk, Pa.

WANTED—Hickok 209A VTVM or equiv. Will pay cash or swap. Leonard Cammarata, 2225 W. 5 St., Brooklyn, N. Y.

FOR SALE—Port. 7" TV, built-in antenna, carrying case, like new $40; Press camera 2¼ x 3¼, comp. outfit; sync. shutter, case, holders, adapters, flash guns, etc. Seldom used, $140. Jacob Dvorkin, 1903 Davidson Ave., New York 53, N. Y.

FOR SALE—SX42 and R42 spkr in perf. cond; Hammarlund 411 xmtr and 420 modulator, like new; NRI xmtr, multitester, and comp. Comm. Course. Frank T. Giudice, 1413 E. Evergreen St., Wheaton, Ill.

FOR SALE—Hallicrafter SX-28 with spkr; exc. cond., $125. Norman Bennett, 301 Holly Rd., Holbrook, Mass.

FOR SALE—25W instant heating 10 meter VFO transmitter, power requirements 6V, 250 to 450 plate voltage, comp. less power supply; price $25 FOB. D. F. Guptill, 17 Park St. Ct., Medford, Mass.

FOR SALE—Rider's vol. 12 $10 plus postage. William Grazier, 4326½ 30th St., San Diego 4, Calif.

SALE OR TRADE—5 table model radios, need slight repairs; National Schools multitester; 22X telescope and 2 sets of double headphones. Karl Nester, Van Meter, Pa.

SELL OR SWAP—"New Products" automatic changer, plays 10-12" or 12-10" records, 78 RPM only, with base. Good shape, $10 cash or $10 worth of tubes of my choice. C. Elgasser, Jr., 1920 Fern St., San Diego 2, Calif.

FOR SALE—Field strength meter; Bogen 32W mobile amp.; 4 University reflex horns; 4 University MP units; 1 mike; 1 stand; A-1 cond. Write for our low price. Carrs Television Center, 15-17 Kelley Square, Worcester 4, Mass.

FOR SALE—Hallicrafter S40-A, like new, $60. Chas. Cerami, 146 Congress St., Newark, N. J.

WANTED—Stancor 202A transmitter. State cond. and price. Hartley Grisham, 911 E. Main St., Marion, Ill.

TRADE—16mm movie projector (Kodascope); comm. rec., Hallicrafter; sig. gen.; 2 TV boosters; Yaugi 4 bar TV aerial; 18W Masco amp. with mike, spkr; wood clarinet. Want 14" TV set, sig. tracer and cond. tester. John Arnold, P.O. Box 84, Bluffs, Ill.

WANTED—Rider Chanalyst, must be A-1; state mod. and price. Henry P. Zych, 5624 W. Byron St., Chicago 34, Ill.

FOR SALE—Rider TV Man. 1-7 $85; 1-5 $60; Rider Radio Man. 1-18 $80; Sams Photo Facts, 8 vol. $80; all in fair cond., intact. Donald E. Schafer, 340 S. Virginia Ave., Burbank, Calif.

SELL OR TRADE—HRO rec., very good shape; 375W xmitter with BC696 v.f.o.; micamold xtr-1, very nice. Eqpt. at my home in Brooklyn. Want mobile eqpt. Peter Schlein, Kappa Nu House, Lenox Rd., Schenectady 8, N. Y.

FOR SALE—Motorola TS-4D 7" TV set, blond cabinet, good cond. $18; RCA Victor mod. 56x10 AM SW table radio $12. Cash with order only. Jones Radio Co., RD I, Douglassville, Pa.

FOR SALE—Air King wire recorder, with mike and 3 spools wire, like new $45; Howard FM tuner, perf., $25; Weston mod. 689 I-F ohmeter, guar., $6. Send M.O. Bert's Radio & TV, 5115 Elyria Ave., Lorain, Ohio.

WANTED—Abbot T-R & B, must be in good cond. Stanford Radio Shop, 2209 N. 16th St., Philadelphia 32, Pa.

WANTED—Instructograph and good comm-rec. E. Tischler, 56 Carey Ave., Wilkes-Barre, Pa.

FOR SALE—Jackson mod. 641 sig. gen; Jackson mod. 645 VTVM, all leads and instructions incl. Best offer takes one or both. Jim Sylvester, 3370 "C" St., Niagara Falls, N. Y.

TRADE—Heathkit 05 oscilloscope and TS-2 marker and sweep gen.; Triplett 1200-A VOM and 1232 sig. gen.; Webster Chicago 78-1 wire recorder. Want tape recorder, Hallicrafter SX-71 or equiv., Speed Graphic, or what have you. Ed's Radio and TV, R 1, Allenton, Mich.

TRADE—Mallory 8301 Inductuner, in orig. carton. Edward Christner's Radio Shop, 313 Crawford St., Middletown, Ohio.

FOR SALE—High and low voltage transx. Type used in no. 7 Telekit TV set., both in good cond; 7 x 50 binoculars with case; German make, E. Leitz. Make cash offer. Stephen Barniak, 2426 Perot St., Philadelphia 30, Pa.

EMPLOYMENT WANTED—T.V. supervisor in large company wants employment in or around Richmond, Va. 17 years experience in electronics, graduate T.V. engineer. References and all information sent on request. John Ferri, Rt. 2, Box 600, Louisville, Ky.

FOR SALE—NRI tube tester, like new $25. Also tube sockets and condensers reas. Alfred A. Johnson, 5604 N. Western Ave., Chicago 45, Ill.

FOR SALE—Teletone AM-FM table radio, 8 tube $30; Samson toaster $12; G.I. 33, 78 rpm phono motors $4; Revere T-100 tape recorder with dynamic mike $115; all excellent. Mrs. Arthur Hein, 418 Gregory St., Rockford, Ill.

SELL OR SWAP—"Practical Radio Comm." and latest "Q & A Book" for FCC exams. Sell for $10 or trade for newest "Keith & Henney Engineering" in excellent cond. Books in orig. cartons. Robert L. Ingram, 140 N. Harrison St., Easton, Md.

WANTED—Precision mod. 864 or 866 multimaster. Will trade RCA Jun. voltohmyst. State cond. and price. Precision Service Co., 2 N. Quincy St., Brockton 58, Mass.

SWAP—5 band Browning preselector for R9'er with 20 meter coil. 813, like new, for Eimac 100TH. John Serafin, 332 Madison Ave., Clifton, N. J.

WANTED—DB22A preselector and VHF-152-A. Joseph A. Stauhs, 159 N. 15th St., Bloomfield, N. J.

WANTED—Tape recorder, semi pro, hi-fi, such as Conertone. Richard Westhoff, 1451 Clayton St., San Francisco, Calif.

SALE OR SWAP—15W Regal port. P.A. system; 2 12" spkrs and mike, all in plastic cov. carrying case, $40 or swap for 630 10" RCA TV table model. J. Heitner, 1183 Grant Ave., Bx 56, N. Y.

FOR SALE—Two Setchell Carlson 32V, 25W 7 tube table sets; one white, one walnut plastic case, at $41.95 and $39.95 less 25% disc.; one Zenith inverter input 32V DC output 110V.A.C., cap. 100W, at $39.50 less 25% disc. FOB. Furch Electric Co., Comfrey, Minn., Box 253.

FOR SALE—H&R Sportsman .22 revolver with holster, perf., FOB $30; National ACSW-3 rec., 10, 20, 160 meter bandspread coils and comp. instr., good, also ext. power supply, poor. All FOB $15. Hal Magargle, 162-20 N. Hempstead Tpke, Flushing 65, N. Y.

FOR SALE—Eico VTVM mod. 221 with HV probe $30; Sylvania polymeter, type 134, make offer; Photofact TV Course; Modern Oscilloscopes; Modern Radio Servicing. H. L. Dean, 671 S. Saybrook Ave., Los Angeles 22, Calif.

WANTED—Sam's folders 1-90 with or without binders. J. E. Smith Radio Shop, Montezuma, Ga.

FOR SALE—Vocatron wireless intercom and baby watcher, 2 units like new; list $79.95, best offer over $50. New York met. area only. H. D. Roistacher, 35-08 95th St., Jackson Heights 72, N. Y.

WANTED—TV field strength meter for fringe area service. Bill's Radio & TV, 2016-B 45th St., Los Alamos, N. M.

FOR SALE—RCA electronic control capacity operated relay no. 41903 using following tubes: 6SQ7, 6F8G, VR-105, 6X5, COD $10; coin-operated station box, used to operate remote radio, comp. with 24 AC motor, spkr and timer clock, $3 each. Victor Kozma, 1665 Stadium Ave., N. Y. 61, N. Y.

FOR SALE—Precision mod. E-200-C sig. gen. $50; Precision mod. 1020-P comb. tube and set tester $85; Supreme mod. 574 VTVM $45; Bud deluxe cabinet rack 37" high with 3 panels $15. Milan Rafajko, 460 N. Lime, Lexington, Ky.

SELL OR TRADE—Motorola car radio; power supplies, dynamotors, transformers, chokes, condensers, meters, crystals; transmitting, receiving, CR tubes, relays, misc. parts; beam rotor motor. Zambakian, 1259 Gaylord, Denver 6, Colo.

SELL OR TRADE—Signal Corps DC VTVM, operates wholly on A and B batteries which last for years. Want 110V oper. VTVM or? Arnold Martin, 114-04 204 St., St. Albans, N. Y. 11, N. Y.

WANTED—Communications receivers, any cond., for Civil Defense. Must be priced low. Frank Sikonski, 19 Oakwood, Saylesville, R. I.

SELL OR TRADE—10 tube transmitter, comp. with modulator, antenna and shock mounts., like new; freq. 500 Mc., but may be mod. for Citizens Radio Band. C. Karlson, 3150 S. Atlanta Rd., Camden 4, N. J.

SELL OR SWAP—Rider Vol. XX, like new, for VTVM, sweep s. g., or will sell. Make offer. Adolf Striberny, Jr., 6605 Martins Mill Rd., Philadelphia 11, Pa.

FOR SALE—BC625 transmitter, unconverted, like new, make offer; Wiremaster Prof. wire recorder, built in AM tuner, phono and extras $195; National HRO, comp., bandspread; make offer. Paul Wunsch, Jr., 421 Clifton Ave., Clifton, N. J.

FOR SALE—SX-71, used 5 hrs. Make offer. Center Television Co., 867 Broad St., Central Falls, R. I.

SELL OR TRADE—Rider record changer book, good 4D32, misc. radio magazines, coax. connectors, National 5886 power sup. for HFS, National HRO-M receiver. Need 829-B, mod. transformers, National HRO-7, late mod. Heathkits. D. C. Harrington, 2137-D 43rd St., Los Alamos, N. M.

WANTED—Scope, Heathkit or Eico, must be in good oper. cond. and reasonably priced. Prefer local seller. Leon Medler, 2109 Daly Ave., Bronx 60, N. Y.

SWAP—.45 cal. Army Colt auto. pistol in exc. cond., 2 clips and ammo included. Want S-40 Hallicrafter rec. in exc. cond. Postler Radio, Rt 2, Box 231 A, Enumclaw, Wash.

TRADE—Federal disc recorder, 16mm 70DA movie camera, fishing rods, shoe skates size 8½, Remington Foursome electric shaver. Want 35mm candid camera, mod. items, or what have you. Stanley T. Jazowski, 335 17th Ave., Irvington 11, N. J.

FOR SALE—Motorola 605 auto radio, like new, universal mounting head fits all cars. At cost $52.50; list $69.95. Al's Service Center, 430 Smith St., Schenectady 5, N. Y.

FOR SALE—Gonset 10-11 converter and noise limiter, $35 FOB; B&W 75W turret $5; 522 transmitter only comp. with tubes $20. Leo Liebl, PSR, Medford, Wis.

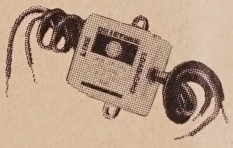
FOR SALE—Rek-O-Kut LP-35 transcription turntable $30; Scott Dynaural noise suppressor $20; Sperti port. ultraviolet lamp $15; Garrard RC-60 changer with GE pickup $20. All FOB, exc. cond. Marilyn Phillips, 311 Penfield Pl., Rockford, Ill.

WANTED—Tape recorder. Send particulars on anything you have to offer. Eugene Kon, 1575 Broadway, Buffalo 12, N. Y.

SALE OR SWAP—Webcor 180 recorder, Scott SLR-H marine rcvr, Wilcox Gay recordette, Motorola 508, Super-pro 210LX, Traveler port., Admiral microgroove rdophono, Precision 954. Need BC 221, Hickok 209, GE ST-2A, tape recorder. John Pellock, 614 W. North, Decatur, Ill.

FOR SALE—S-29-S-38, separate spkr; Kenyon T-301 PA output transf; LQ-D1M phono cartridge; AC, DC, FP condensers; HROW, 13 coils, spkr and spare parts. Write for list. M. Schmitz, 2135 W. Berteau Ave., Chicago, Ill.

That interference problem?

...Sure!  there's a C-D filter just for it!

- Feed-thru and Pi filters for mobile, aircraft and marine equipment.
- Ignition and interference filters for use on generators, ammeters, etc.
- Quietone interference filters, for home, industrial and heavy-duty electrical equipment.
- Made by C-D, world's largest producer of interference filters.
- Write for Catalog 200 C. Cornell-Dubilier Elec. Corp., So. Plainfield, N. J. Your local Classified Phone Directory lists your nearest C-D jobber.

CONSISTENTLY DEPENDABLE

CORNELL-DUBILIER

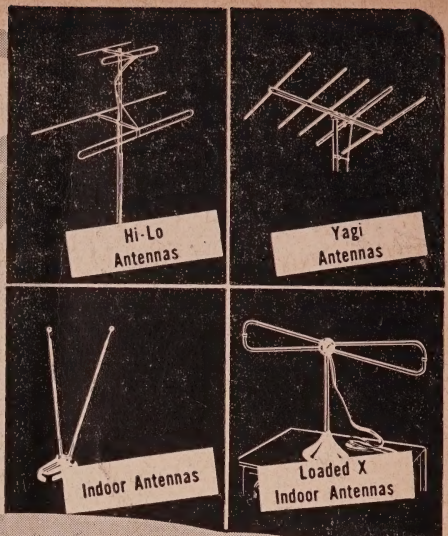
CAPACITORS

SUBSIDIARY

Plants in South Plainfield, N. J.; New Bedford, Worcester, and Cambridge, Mass.; Providence, R. I.; Indianapolis, Ind.; Fuquay Springs, N. C.; and subsidiary, The Radiart Corp., Cleveland, Ohio

a model to fit any application

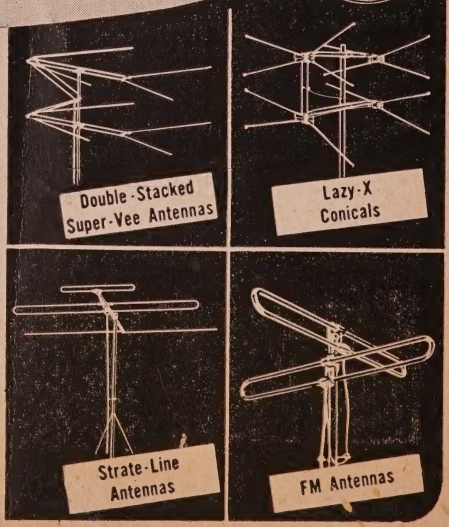
the antenna job hasn't been found that a C-D SKYHAWK ANTENNA can't handle.



C-D Skyhawk TV ANTENNAS

SUBSIDARY

CORNELL-DUBILIER offers you, the discriminating serviceman, a line of antennas unequaled in completeness. Regardless of the application, regardless of the situation, there is a C-D SKY-HAWK ANTENNA to fill the bill. Don't risk inferior substitutes when you can be sure of the painstaking construction and outstanding performance of CORNELL-DUBILIER antennas.



CORNELL-DUBILIER
ELECTRIC CORP.
SOUTH PLAINFIELD, N. J.